

Proper service and repair procedures are vital to the safe, reliable operation of all motor vehicles as well as the personal safety of those performing the repairs. Standard safety procedures and precautions (including use of safety goggles and proper tools and equipment) should be followed at all times to eliminate the possibility of personal injury or improper service which could damage the vehicle or compromise its safety.



INTRODUCTION

BMW M62TU Vanos Removal and Repair

BMW's Vanos variable valve timing system is one of the most recognized systems in the industry. There are a number of different designs, and they all work off of ingeniously simple mechanical principals. Their notoriety, however, is not likely to be from their design and performance, but more so from the fact that they frequently wear out. Luckily, the majority of the problems are caused by worn seals, which can easily be replaced. Today we're going to be installing our rebuild kit into the Vanos units that are found in the 8 cylinder M62TU engines. One of the symptoms of Vanos malfunction is the well known "Vanos rattle". In the case of the M62TU engines, it's caused by a loose Vanos seal carrier which is housed inside the Vanos unit itself. The only way to remedy this problem is to replace the seals and crimp down the outer lip of the Vanos unit to secure the seal carrier in place, and we now offer a special crimping tool that will allow you to successfully complete this repair. Installing the rebuild kit into your M62TU Vanos may seem a little daunting at first, but it's really a fairly easy project, and it'll restore smooth, consistent performance, some of which you may not even realize you've lost.

ECS Difficulty Gauge



You'll want to take your time on this project, and it's best to plan a couple days for it so you don't try to rush through it. The best advice, as always, is to read through these instructions first to familiarize yourself with the job and make sure you have all of the required tools on hand. *This job will require specific engine timing tools - see Page 6*. There is no work-around or "trick" method available. These tools are a must have for the job.

One more thing, you'll see that we don't get too in-depth with our instructions until we get down to the Vanos unit itself. We list everything that you'll need to remove, but the disassembly up to that point is fairly routine, and we're confident you can handle it.

Thank you for looking to ECS Tuning for all your performance and repair needs, we appreciate your business!



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This Vanos and Cam Timing Tool Kit is required for the job (see page 6) - <u>ES#3188300</u>



This Vanos Press tool is required (see page 6) - <u>ES#3241167</u>



This water pump and fan clutch tool kit will make disassembly much easier - ES#2627584



M62TU VANOS REBUILD COMPONENTS

View our *Dynamic Kit* (ES#3410414) and select from multiple options





REQUIRED TOOLS

Note: The tools required for each step will be listed by the step number throughout these instructions.

Standard Automotive Tools

Required For This Install

Available On Our Website

| Protecta-Sockets (for lug nuts) | <u>ES#2221243</u> |
|--|---------------------|
| • ³ /8 ["] Drive Ratchet | . <u>ES#2765902</u> |
| • ³ /8 ["] Drive Torque Wrench | . <u>ES#2221245</u> |
| • ³ / ₈ " Drive Deep and Shallow Sockets | . <u>ES#2763772</u> |
| • ³ / ₈ " Drive Extensions | . <u>ES#2804822</u> |
| Hydraulic Floor Jack | . <u>ES#240941</u> |
| Torx Drivers and Sockets | <u>ES#11417/8</u> |
| • 1/2" Drive Deep and Shallow Sockets | . <u>ES#2839106</u> |
| • ½" Drive Ratchet | |
| • 1/2" Drive Extensions | |
| • 1/2" Drive Torque Wrench | . <u>ES#2221244</u> |
| • ½" Drive Breaker Bar | . <u>ES#2776653</u> |
| • File Set | |
| • Air Nozzle/Blow Gun | |
| Bench Mounted Vise | |
| Crows Foot Wrenches | |

Hook and Pick Tool Set
 <u>ES#2778980</u>

| • ¼" Drive Ratchet | <u>S#2823235</u> |
|---|------------------|
| • 1/4" Drive Deep and Shallow Sockets | <u>S#2823235</u> |
| • ¼″ Drive Extensions | <u>S#2823235</u> |
| • ¼″ Drive Torque Wrench | |
| Plier and Cutter Set | <u>S#2804496</u> |
| Flat and Phillips Screwdrivers | <u>S#2225921</u> |
| • Jack Stands | <u>S#2763355</u> |
| Ball Pein Hammers | |
| • Pry Bar Set | <u>S#1899378</u> |
| Electric/Cordless Drill | |
| Wire Strippers/Crimpers | |
| Adjustable (Crescent) Type Wrenches | |
| • Drill Bits | |
| Punch and Chisel Set | |
| Hex Bit (Allen) Wrenches and Sockets | <u>S#11420</u> |
| Thread Repair Tools | <u>S#1306824</u> |
| • Open/Boxed End Wrench Set E | <u>S#2765907</u> |

Specialty Tools

| Vanos & Timing | Tool Kit | <u>ES#3188300</u> |
|--|----------|-------------------|
| | | |

- Vanos Crimping Tool
 <u>ES#3241167</u>
- 27mm Socket......<u>ES#2702840</u>
- 27mm Open End Wrench



ES#3410414



SHOP SUPPLIES AND MATERIALS

Standard Shop Supply Recommendations: We recommend that you have a standard inventory of automotive shop supplies before beginning this or any automotive repair procedure. The following list outlines the basic shop supplies that we like to keep on hand. Shop supplies with a hyperlink are available on our website.

- Hand Cleaner/Degreaser <u>Click Here</u>
- Pig Mats for protecting your garage floor and work area from spills and stains Click Here
- Spray detailer for rapid cleaning of anything that comes into contact with your paint such as brake fluid Click Here
- Micro Fiber Towels for cleaning the paint on your car Click Here
- Latex Gloves for the extra oily and dirty jobs Click Here
- Medium and High Strength Loctite Thread lock compound to prevent bolts from backing out Click Here
- Anti-Seize Compound to prevent seizing, galling, and corrosion of fasteners Click Here
- Aerosol Brake/Parts Cleaner for cleaning and degreasing parts
- Shop Rags used for wiping hands, tools, and parts
- Penetrating oil for helping to free rusted or stuck bolts and nuts
- Mechanics wire for securing components out of the way
- Silicone spray lube for rubber components such as exhaust hangers
- Paint Marker for marking installation positions or bolts during a torquing sequence
- Plastic Wire Ties/Zip Ties for routing and securing wiring harnesses or vacuum hoses
- Electrical tape for wrapping wiring harnesses or temporary securing of small components

INSTALLATION NOTES

- **RH** refers to the *passenger side* of the vehicle.
- **LH** refers to the *driver side* of the vehicle.
- Always use the proper torque specifications.
- If applicable to this installation, torque specifications will be listed throughout the document and at the end as well.
- Please read all of these instructions and familiarize yourself with the complete process **BEFORE** you begin.

GENERAL PREPARATION AND SAFETY INFORMATION

ECS Tuning cares about your health and safety. Please read the following safety information. This information pertains to automotive service in general, and while it may not pertain to every job you do, please remember and share these important safety tips.

- Park your car in a safe, well lit, level area.
- Shut the engine off and remove the key from the ignition switch.
- Make sure any remote start devices are properly disabled.
- ALWAYS wear safety glasses.
- Make sure the parking brake is applied until the vehicle is safely lifted and supported.
- If using an automotive lift, be sure and utilize the factory specified lift points. Lifting a vehicle in an incorrect location can cause damage to the suspension/running gear.
- When lifting a vehicle using a jack, always utilize the factory specified lift points. Lifting a vehicle in an incorrect location can cause damage to the suspension/running gear. **ALWAYS** support the vehicle with jack stands.
- Always read and follow all safety information and warnings for the equipment you are using.



NEVER get underneath a vehicle that is supported only by a jack, and ALWAYS make sure that the vehicle is securely supported on jack stands.

BMW's M62TU Vanos (Variable Valve Timing) system is actually quite simple to work on and understand. To explain its operation, we'll first look at a few basic points regarding the timing chain and cam timing, then we'll run through the operation.

- Each *intake* camshaft has a double sprocket mounted on the end.
- Each *exhaust* camshaft has a single sprocket mounted on the end.
- The M62TU Vanos units are integrated into the *intake* camshaft sprockets.
- One timing chain runs from the crankshaft and drives the larger *intake* camshaft sprockets.
- On each bank, one timing chain runs from the smaller intake camshaft sprocket and drives the *exhaust* camshaft sprocket.

Now let's start to get familiar with some of the components. Shown on the right is a view of what you will see once you have removed the valve covers and upper timing covers in order to perform Vanos service.

The LH side (Bank #2) is shown, and the RH side for the sake of understanding system operation - is exactly the same. (There are some relevant differences, but they will be covered later).

The camshaft timing wheel does not time or adjust the actual *intake* camshaft itself, but it serves as the pickup for the camshaft position sensor that is mounted in the front of each upper timing cover. Using a special tool, the timing wheel must be precisely positioned for proper system operation. The nut that holds it in place is "reverse" (LH) thread.



The beauty of timing these systems is that during disassembly, all four of the camshafts **and** the crankshaft are locked in place using special tools, and **none** of the camshaft sprockets are keyed or indexed to the cams. What this means is that during reassembly, you simply install and tension the chains, retard the Vanos units, then tighten the camshaft sprockets, and timing is set! Don't be intimidated, this is one of the easiest engines to time. There are however a couple tricks to know, and we're going to cover them so you'll be guaranteed perfect timing the first time.



Once the *intake* sprocket/Vanos unit is removed from the *intake* camshaft, the Vanos hub can be pulled out and removed. With the hub removed, you'll see the gear teeth on the O.D. of the Vanos piston. When you flip the Vanos hub over, you'll see the mating gear teeth on it's I.D. It's these gears, and oil being directed to either side of the Vanos piston, that makes the Vanos unit work. There is a thrust washer underneath the Vanos hub and when you remove the Vanos hub, sometimes it comes off with it, and sometimes it stays in the piston as shown here.



OK, now we're getting to the nitty-gritty. When you pull out the Vanos hub, it rotates slightly, when you push it back in, it rotates in the other direction. This is due to the angle of the gear teeth on the Vanos piston and Vanos hub (these are called helical gears). With the Vanos hub removed, you can also move the Vanos piston in and out - and you'll see that it rotates back and forth too. Now, if you remove the thrust washer, you'll see *two more* sets of gear teeth. One on the I.D. of the Vanos piston (you'll have to move the piston outward to see them), and the final set in the middle of that, which is actually a fixed part of the *intake* camshaft sprocket itself.



Let's review up to this point:

- We know there is a helical gear on the intake camshaft sprocket.
- We know there is a helical gear on the inside of the Vanos hub.

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The Vanos piston has two helical gears, the inner that meshes with the intake cam sprocket gear, and outer that meshes with the gear on the inside of the Vanos hub.

Oil pressure, directed to the front or back of the Vanos piston causes it to move in and out within the Vanos unit. Since we know that the piston is connected by helical gears to the intake camshaft sprocket on one side and the Vanos hub on the other, and we have seen how the Vanos piston and Vanos hub rotate, we can then understand:

As the Vanos piston moves in and out, it causes the Vanos hub to rotate back and forth. This back and forth rotation is referred to as Advancing and Retarding.

And, since the Vanos hub is bolted directly to the intake camshaft, we therefore know that as the Vanos piston moves in and out within the Vanos unit, the intake camshaft rotates back and forth, or advances and retards. Remember, the camshaft gears are permanently timed to the crankshaft via the chains, it's only the Vanos hub, and intake camshaft that can advance or retard.

When oil is directed to the front of the Vanos piston, it moves inward and causes the Vanos hub to rotate clockwise, advancing the intake cam timing.

When oil is directed to the back of the Vanos piston, it moves outward and causes the Vanos hub to rotate counter-clockwise, retarding the intake cam timing. 0)(0) 0000 00000000000 The cam gears are permanently timed to the crankshaft via the chains.

Now let's take a look under the hood at some of the components in their installed locations. The valve covers and coolant hoses have been removed to gain access to this point.



Here's the final piece of the puzzle to bring it all together. Once you remove the upper timing covers, the chains, and the camshaft sprockets/Vanos units, you'll see the Vanos oil distribution housings.



The Vanos oil distribution housings bolt to the front of each cylinder head, and the Vanos control solenoids mount into a cavity in each one. The distribution housing does nothing more than direct the oil to the end of each intake camshaft.



Here's a close up of the end of the intake camshaft. There are three sealing rings on the end to provide a continuous seal between the camshaft and the oil distribution housing. Note the holes in the end of the camshaft. The pressurized oil travels through the Vanos solenoid and distribution housing, then through the end of the camshaft and into the intended chamber of the Vanos unit housed in the intake camshaft sprocket.

Now that you understand how the Vanos system operates from a mechanical standpoint, here's a final wrap up with a flow chart of operation. The Vanos system is continuously advancing or retarding intake cam timing, based on the performance that is requested (driver input).



Side to Side Comparison

Here are the side to side differences of the M62TU Vanos/timing chain setup.



The lower timing chain tensioner is on Bank #1, and is mounted in the upper timing cover (timing cover not shown).

ACCESSING THE VANOS UNITS

Now that you're an expert on Vanos operation, it's time to get started! As we mentioned in the introduction, we're just going to list the preliminary steps to get you down to the good stuff, then we'll dig in from there. Here we go.



You will find that some parts are symmetrical front-to-back and top-to-bottom, and can be installed on either side. While in most cases this is not a problem, in order to make absolutely sure that everything is correctly reassembled and parts that have worn in together continue to work in harmony, we highly recommend that you have a large, clean work area and as you remove components, be sure to lay them out, keeping them organized side-to-side and front-to-back.

- Step 1: Disconnect the battery (the positive jump start lug is on the LH valve cover and it'll have to come off).
- Step 2: Remove the upper engine cover.
- **Step 3:** Remove the air box and intake tube.
- Step 4: Remove the lower engine insulation panels (or skid plate if you have one).
- **Step 5:** Drain the engine coolant.
- **Step 6:** Remove the mechanical radiator fan, the radiator shroud, and the coolant reservoir.
- **Step 7:** Remove the upper and lower radiator hoses.
- **Step 8:** Remove the left and right cabin filter housings and ducts.
- **Step 9:** Remove the ignition coil covers and all 8 ignition coils.
- **Step 10:** Disconnect the coil and fuel injector connector housings and tie them together in the middle so they are clear of the valve covers. There are a couple of solenoids and brackets here that you'll have to remove and the fuel injector connectors are a little hidden, so you'll need a flashlight and a long pick to release them.
- **Step 11:** Remove the valve covers.
- Step 12: Remove the four oil rails.
- **Step 13:** Remove the secondary air pipe across the front of the engine.
- **Step 14:** Remove the dipstick tube bracket, hose and cable mounting brackets, and fuel purge valve bracket (anything that is in the way of removing the timing covers).



INTERMISSION

It's time to take a break and switch gears. We're going to get a little more detailed at this point in the game, and before we continue, there's a few things we like to do that will make things go a little easier.

To begin with, it's a good time to clean up and put tools away. This will eliminate extra clutter and give you a little more working room to lay out all of the timing and Vanos components and keep them in order.

You will find that some parts that are symmetrical front-to-back and top-to-bottom, and can be installed on either side. While in most cases this is not a problem, in order to make absolutely sure that everything is correctly reassembled and parts that have worn in together continue to work in harmony, we highly recommend that you have a large, clean work area and as you remove components, be sure to lay them out, keeping them organized side-to-side and front-to-back.

OK, back to it!

Step 1: 27mm Socket, Ratchet

Rotate the engine in a clockwise direction using a socket and ratchet on the crankshaft pulley bolt, until cylinder #1 is at TDC. There are two conditions that must be met which will indicate this:

- 1. Lining up the marks on the crank pulley and the lower timing cover.
- 2. The lobes on the intake and exhaust camshafts for cylinder #1 will face each other.



Step 2:

Confirm that the crankshaft and lower timing cover marks are lined up and that the cylinder #1 cam lobes are facing each other.



Step 3:

Locate the crankshaft locking pin hole and inspection plug, underneath between the engine and transmission.

Remove the inspection plug, then using a flashlight and rotating the engine slightly backward or forward as necessary, insert the crankshaft locking pin through the hole and into the flywheel or flexplate.



If you are using a straight locking pin, you will have to turn the steering wheels full lock to one side or the other. This will cause the center link to swing towards the front, allowing the tool to be inserted into the hole.

Step 4: 19mm Socket, Ratchet

Remove the lower timing chain tensioner, located on the side of the upper timing cover on Bank #1 (passenger side).





Step 5:

10mm Socket, Ratchet, Vanos Solenoid Socket

Remove the Vanos control solenoids (highlighted in **GREEN**) in three steps:

- 1. Disconnect each solenoid electrical connector.
- 2. Remove each solenoid sealing plate.
- 3. Remove each solenoid using the solenoid socket.



Vanos Solenoid



Step 6: 10mm Socket, Ratchet

On each timing cover, disconnect the camshaft position sensor electrical connector, then remove the six bolts and remove the covers. The *camshaft position sensors can remain installed* in each cover, and you may have to *pry the covers loose* due to sealant holding them in place.



On the Bank #2 cover (driver side), the inner lowest bolt will not slide out due to interference. The bolt will remain in place and be removed with the cover.





Step 7:

Now it's time to lock the cams in place. Take a look at the cam locking blocks. They are marked with the cylinder identification 1-4 (Bank #1) and 5-8 (Bank #2). They are also marked indicating the intake or exhaust cam, which on some tools, such as the ones shown here, carry the German abbreviation of "A" for Auspuff (exhaust) or "E" for Einlass (intake).

Each one is held together in the middle by a bolt requiring a 6mm Allen.



Step 8:

Close inspection of the end of each camshaft will reveal the same identification as on the cam blocks, such as this one shown here indicating the intake camshaft for cylinders 5-8 (Bank #2).

Notice how the end of each camshaft is squared off, which correspondingly fits into the squared off portion of the cam locking blocks.

Another important detail to notice is that each camshaft has a hex cast into it towards the rear of the cam. This hex can be used to rotate the camshaft back and forth slightly with a 27mm or adjustable wrench in order to line it up precisely with the cam locking block.



27mm Wrench Step 9:

Slide each camshaft locking block into place so it is fully engaged with the end of each camshaft, and also completely flat against the surface of the cylinder head. You may loosen the center bolt if necessary to allow for easier alignment, however you must be sure and re-tighten it once the blocks are installed and against the cylinder head.

Don't forget to rotate or rock the cam back and forth slightly if necessary (using a wrench on the hex) to line it up while installing the locking blocks.





27mm Wrench Step 10:

You will find that the Bank #1 intake camshaft seems to be misaligned more than the rest. This is normal, and you will have to rotate it counter clockwise (using a wrench on the hex) to overcome valve spring pressure and align it with the locking block.

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VANOS - TIMING AND REPAIR

Step 11: 27mm Open End Wrench

The hex on each intake camshaft is *critical* for the next step, so be prepared to counter hold the intake cams.



Remove both camshaft timing wheels in the following manner: One at a time, *counter hold the intake camshaft*, then loosen and remove the timing wheel nut and timing wheel.



CAUTION: Note that these are LH (reverse) thread. These must be loosened in a *clockwise* direction, and you must counter hold the camshaft or it may be damaged. The square end is not strong enough to hold the cam by itself.





Step 13: T55 Torx, Breaker Bar, 27mm Open End Wrench

Counter-hold each camshaft, then loosen the two Vanos mounting bolts (highlighted green) and the two exhaust camshaft sprocket bolts (highlighted red). Do not remove them at this time, loosen them only.



CAUTION: Note that these are LH (reverse) thread. These must be loosened in a *clockwise* direction, and you must counter hold each camshaft or it may be damaged. The square end is not strong enough to hold the cams by themselves.



Step 14:

Compress both exhaust cam chain tensioners and insert the locking pins into place (highlighted in **GREEN** in the photo below).



Be sure and leave these locking pins in place until the chains are reinstalled during assembly.





Step 15: T55 Torx

Remove both Vanos mounting bolts and both exhaust camshaft sprocket bolts, but leave the Vanos units and exhaust sprockets in place.



CAUTION: These are LH (reverse) thread and MUST be removed in a *clockwise* direction.



Carefully remove the exhaust sprockets and the Vanos units by pulling them off the camshafts and lifting off the chain, laying them on a bench to keep them in position.



If you are replacing the distribution housings, camshaft sealing rings, and oil check valves, continue with step 17. If you are not replacing these components and rebuilding the Vanos units only, skip to <u>Step 1 on Page 33</u>. Note that an inspection/ replacement of these items is highly recommended unless you are certain of their service history.





Step 17:

Gently guide the timing chains around the distribution housings and lay them off to the side.



Step 18:

Using lint free rags or towels, cover the lower timing cover openings so you do not drop anything down into the engine in the following steps.



Step 19: E10 Torx Socket

Remove the Vanos distribution housing bolts on both the left and right banks. There are five bolts on each one (the housings are highlighted in **GREEN** in the photo).



Step 20:

Gently work the distribution housings back and forth until they slide off the ends of each camshaft.

With the distribution housings removed take note of the following four items on each side:

- 3x Camshaft Sealing Rings (GREEN Arrows)
- 1x Distribution Housing Gasket (RED Arrow)
- 1x Oil Check Valve (BLUE Arrow)
- 1x Exhaust Cam Chain Tensioner (ORANGE Arrow)



Step 21:

Closely inspect the bore of the distribution housings. It should be smooth, with no grooves or scoring. If there is any scoring present, the housings must be replaced. Early housing versions were not coated, and they should always be replaced with later Teflon[™] coated housings.



Step 22:

Replace both oil check valves. Use a 10mm x 1.0 bolt threaded into the end to pull them out and reinstall them.



Step 23:

Clean the sealing surfaces and install new distribution housing gaskets.



Step 24:

Replace the three camshaft sealing rings by unhooking the ends and guiding them out of their grooves.



Step 25:

The exhaust cam chain tensioners are replaced by removing the two nuts holding them in place, then prying them upward to remove them off of the cylinder head. If you replace these, remember to leave the locking pins installed for now.



Step 26:

Once you have inspected and replaced the camshaft sealing rings, distribution housings gaskets, oil check valves, and exhaust cam chain tensioners as needed, carefully slide the distribution housing over the end of each camshaft until they are fully seated on the cylinder head, then install and torque the five bolts on each one.

It's time to rebuild your Vanos units!



Step 1:

Thoroughly clean the Vanos unit, but be careful that it does not come apart. The hub easily separates from it, but they must be marked first so they can be reassembled correctly.



Step 2:

Hold the Vanos unit and rotate the hub *fully clockwise* until it stops. To ensure that it is *fully clockwise*, it helps to rotate it back and forth so you can feel the stops. The hub only rotates a total of about 25-30 degrees.



Step 3:

With the hub rotated fully clockwise, make alignment marks on the hub and the Vanos unit. Use a permanent marker or paint so they cannot be easily wiped off.



Step 4:

Pull up on the hub and remove it from the Vanos unit. Because of the angle of the gears inside, the hub will rotate slightly clockwise as you remove it. Take note of this, and the relative position of the marked line on the hub. This will be important for reassembly.



Step 5:

After removing the hub from the Vanos unit, you will find a washer that is located in between the two. The washer will either stay in the center of the Vanos piston, or it will stick onto the bottom side of the hub. It has been removed and placed in between the two in this picture.



Without Washer With Washer Image: With Washer

Step 6:

Reinstall the washer (if it's not still there) into the center of the Vanos piston. Although it does not affect the rebuilding of the unit, it allows you to keep track of it and it gives you a small lip to grab onto that will help you slide the piston outward.

Note the position of the Vanos piston in these pictures. The piston (arrow) is all the way in.

Step 7:

The seals that need to be replaced are not visible, but located just under the lip of the plastic seal carrier as indicated by the highlighted green area in the photo.



Step 8:

To gain the necessary access to remove the seals, you must slide the Vanos piston fully upward in the housing, as shown in the picture. You can do this by pulling it upward with help of the center washer, or by turning the housing upside down and shaking it until the piston slides out.



Step 9: Angled Pick Tool

Angled Lick 1001

Angled Pick Tool

and remove it in the same manner.

Step 10:

The Teflon[™] seal is removed first. While holding the piston up, use a pick tool to reach in and snag the Teflon[™] seal, then pull it out from the plastic seal carrier.

Now move onto the rubber support o-ring just behind the Teflon[™] seal





Step 11:

Flush out the groove of the plastic seal carrier (where the Teflon[™] seal and plastic o-rings were just removed from) using brake cleaner.



Step 12:

Start the new Vanos o-ring into the groove.



Step 13: Angled Pick Tool

Gently guide the o-ring into place, carefully using a pick tool to push it into the groove. As you work your way around the carrier, you will end up with a small area of the o-ring protruding which you can push into place to complete the installation.





CAUTION: Make sure the piston remains fully extended upward while installing the seal to avoid slicing it on the teeth.

Step 14:

Now it's time to install the Teflon[™] seal, which is just a little trickier. The key is to warm it up first, so begin by placing it in a bowl of warm water for at least two minutes.



Step 15:

With the seal warmed up, and making sure the Vanos piston stays fully extended upward, insert the new Teflon[™] seal into one side of the groove, pushing it against the o-ring as shown.



Step 16: Angled Pick Tool

Take your time, carefully and slowly working the Teflon[™] seal into place against the o-ring. Use a small angled pick to guide it into place, and keep it seated against the o-ring as you work. It usually, takes 3-5 minutes to work the seal into place, so don't think you're doing it wrong, it just takes time. Continue to work until you get close to the end, as shown in this picture.



CAUTION: Do not use the sharp end of the pick so the seal isn't damaged, but don't be concerned about pressing against it with the sides or edges. The Teflon[™] is incredibly resilient, and will recover from small indentations.



Step 17: Angled Pick Tool

Use a pick to push and guide the final part of the Teflon[™] seal down into place over the o-ring. It is normal for the Teflon[™] seal to wrinkle slightly at this point.



Step 18: Angled Pick Tool

With the Teflon[™] seal in place, work your way all around it, seating it against the o-ring underneath.



Step 19:

As a final check to confirm that the Teflon[™] seal is properly installed, inspect it closely around the entire circumference. If fully seated against the o-ring, only the very edge of it will be visible.



Step 20:

Reinstall the hub, making sure to start with the alignment mark slightly clockwise of the mark on the Vanos unit, so when the hub is fully installed the two marks will be perfectly aligned.



Step 21:

The two marks should be perfectly aligned when the hub is reinstalled in the correct position.



Step 22:

As a final check, rotate the hub back and forth to make sure it operates smoothly.



When crimping the lip of the Vanos housing (beginning on the next page) you will have to remove the hub, so be sure and leave the alignment marks intact.



Step 1:



To crimp the lip of the Vanos housing, the hub will have to be removed. Make sure the alignment marks are still visible between the hub and housing.

Over time, a gap will form between the plastic seal retainer and the upper lip of the housing. The gap may be close to 1mm in size and can easily be seen. The Vanos lip must be crimped down to eliminate this gap. Pressing down on the plastic seal carrier with a flat blade screwdriver will fully seat it in the Vanos unit and expose the gap.



CAUTION: If no gap is found between the plastic seal retainer and the upper lip of the housing **DO NOT** perform this procedure. Skip to Page 49.

Step 2:

Inspect the ECS Tuning Vanos press cup and the Vanos unit. There are three holes in the Vanos tool which are designed to fit over the pins in the Vanos unit.





Step 3:

Place the press cup on top of the Vanos unit, making sure the pins are all located inside the holes.



Step 4:

Securely clamp the flats on the press cup into a vise.



Step 5:

Insert the pressing screw through the press plate so the step on the plate is on the thread side of the screw, then apply graphite grease to the threads on the pressing screw, and apply grease underneath the head of the screw as well.



Step 6:

Insert the pressing screw through the press plate and Vanos unit, then thread it into the press cup on the bottom.



Step 7: 27mm Socket, Ratchet

Tighten the pressing screw until it snugs up and the Vanos unit is held between the press cup and plate.



| tep 8: 27mm Socket, ½" Torque Wrench |
|--------------------------------------|
|--------------------------------------|

Torque the pressing screw to 136 Nm (100 Ft-lbs).



Step 9: 27mm Socket, ½" Breaker Bar

Mark the head of the pressing screw, the press plate, and the inner Vanos sprocket for reference, then tighten the screw a full additional turn (360 degrees). With grease under the head of the pressing screw, the press plate should not turn at the sprocket. Be sure to confirm this as you tighten it and use the mark on the sprocket along with the mark on the head of the screw for indication of a 360 degree rotation.



CAUTION: This will require a lot of force. Be sure to counter-hold the socket at the fulcrum point to prevent the Vanos unit from twisting out of the vise. It is also helpful to have an assistant during this step.

Step 10:

Remove the pressing tools and you will see how the lip of the Vanos housing has been crimped, eliminating the gap between it and the seal carrier.



To remove the press cup, thread the pressing screw in without the press plate, then turn the assembly over and hit the head of the pressing screw on the vise anvil.







Step 1:

Reassembly is almost easy enough to say "reverse of removal", but we're going to give you a little more than that. To begin the process, mount the Vanos units and exhaust sprockets back onto the camshafts along with the chains (both banks - only one is shown here for reference).



There is no specific orientation of the cam chains to the sprockets.

Step 2: T55 Torx

Install the Vanos and exhaust camshaft sprocket bolts, tighten them just until they are snug so the sprockets are fully seated, then loosen them slightly so both sprockets can rotate during tensioning of the timing chains.

Now remove the locking pins from the exhaust cam chain tensioners.







Step 3: 10mm Socket, Ratchet

Install the timing chain tensioning block onto the front of the Bank #1 cylinder head, using timing cover bolts.



Step 4:

Tighten the tensioning screw by hand until the slack is taken out of all three chains.



If the slack is not removed from all three chains, check to make sure that the Vanos and exhaust camshaft bolts are loose.





Step 5:

Double check both camshaft locking blocks to make sure they are engaged onto the camshafts and flat on the cylinder head surface. Reposition them as necessary.



Step 6: Vanos Hub Tool

Fully retard both Vanos hubs by turning them counter-clockwise to their stops (special tool from kit), then tighten the Vanos hub bolts and exhaust camshaft bolts *by hand only* to lock the timing in place.

The three pins on the Vanos unit can be used to check for a fully retarded position of the Vanos hub. In this position, the pins will contact the Vanos piston, creating electrical continuity between the pins and a good ground. Using a DVOM, a zero ohm reading will indicate this fully retarded position. This is a common practice, but sometimes difficult to obtain a reading, so we prefer simply rotating the hub counter-clockwise until it stops.





Step 7: T55 Torx, Torque Wrench

Counter-hold the camshafts and torque the Vanos and exhaust sprocket bolts to their final torque.



Step 8:

Mount the timing wheels onto the Vanos mounting bolts, and loosely install the timing wheel nuts.





Step 9: Timing Wheel Tool, 24mm Socket, Torque Wrench

On both sides, rotate the timing wheel to align the hole in the wheel with the pin on the alignment fixture, then mount the alignment fixture onto each cylinder head using timing cover bolts.

Once the fixture is in place, torque the timing wheel mounting nut (in a counter clockwise direction) to 40 Nm (29.5 Ft-lbs).





Step 10:

Remove the camshaft blocks, the timing wheel alignment fixtures, and the crankshaft pin.

Rotate the crankshaft two full revolutions in a clockwise direction, then reinstall the crankshaft pin, the cam blocks, and the timing wheel alignment fixtures. *Everything must line up correctly* or you will need to adjust the timing.



NOTE

The Bank #1 intake camshaft will rotate when the locking blocks are removed due to valve spring pressure.



Step 11:

Once you have confirmed all timing, remove all timing fixtures, including the chain tensioning block.

Be sure and install a new chain tensioner seal at this time (arrow).



Step 12:

Clean the upper timing covers and replace both seals. Prior to installing the covers, apply sealant to the lower corners (arrows).





Step 13: 10mm Socket, Extension, Torque Wrench

Loosely install the upper timing covers, then install the valve covers *without the gaskets*. Install and tighten four valve cover nuts (arrows), then torque the timing cover bolts to 9 Nm (6.5 Ft-lbs).



CAUTION: This procedure is necessary to properly seat the timing cover seals, to allow for proper alignment of the Vanos solenoid seals, and to provide proper alignment of the camshaft sensor to the timing wheel.

Remove the valve covers after torquing the timing cover bolts.



Step 14:

Install the lower timing chain tensioner into the timing cover on Bank #1, then install the Vanos solenoids, followed by the new Vanos solenoid seals, and, you are just a short time away from completing your installation!



Return to Page 18 and reinstall all components in the reverse order of removal.





TORQUING TIPS

Torque to Yield or "Stretch" Bolts

Many bolts will have a torque specification listed in the format - xx Nm (xx Ft-lbs) + xx degrees. These bolts are torque to yield bolts, commonly referred to as "stretch" bolts. The correct procedure for torquing these bolts is:

Stage One - Torque the bolt(s) to the initial Nm or Ft-lb specification. If there is more than one, be sure to torque them in the correct sequence. Stage Two - Tighten or "stretch" the bolt(s) the additional specified number of degrees. If there is more than one, be sure to follow the correct sequence.

Note - Some bolts may have two or more stages of torquing before the final stage of "stretching" the bolts.

When tightening more than one bolt in a specified sequence, be sure to mark each fastener with paint *immediately* after performing the final stage or "stretching" of the bolts. This will ensure that you keep track of which bolts have already been "stretched".

All Torque to Yield bolts should only be used once and should be replaced each time they are removed. If they are reused, they will not be able to achieve the proper clamping force with the specified torque.

Lubrication

Torque specifications are always listed for a dry fastener (no lubrication) unless specified otherwise.

Some fasteners require lubrication on the threads -or- on the contact surface while torquing. These fasteners will be listed with the specific location and type of lubrication required. Always follow manufacturers recommendations exactly.

Lubricating a fastener that is intended to be installed dry and then torquing it to factory specifications will increase the clamping force and stress on the fastener and components, which can result in damage or failure.

Do not lubricate the threads of any fastener unless it is specifically recommended by the manufacturer.

Ribbed vs. Non-Ribbed Bolts





TORQUE SPECIFICATIONS

| 8 Nm (6 Ft-lbs) |
|---------------------|
| 10 Nm (7.5 Ft-lbs) |
| 125 Nm (92 Ft-lbs) |
| 110 Nm (81 Ft-lbs) |
| 40 Nm (29.5 Ft-lbs) |
| 40 Nm (29.5 Ft-lbs) |
| 9 Nm (6.5 Ft-lbs) |
| 8 Nm (6 Ft-lbs) |
| 25 Nm (18.5 Ft-lbs) |
| 9 Nm (6.5 Ft-lbs) |
| |

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Your BMW M62TU Vanos rebuild is complete!



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